

PTO 04-3868

CY=DE DATE=19851031 KIND=A1
PN=34 14 556

METHOD FOR BIOLOGICAL REMOVAL OF NITRATE AND/OR NITRITE FROM WATER
[Verfahren zur biologischen Entfernung von Nitrat und/oder Nitrit aus
Wasser]

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UNITED STATES PATENT AND TRADEMARK OFFICE
Washington, D.C. June 2004

Translated by: FLS, Inc.

PUBLICATION COUNTRY (10) : DE

DOCUMENT NUMBER (11) : 3414556

DOCUMENT KIND (12) : A1
(13) : Application

PUBLICATION DATE (43) : 19851031

PUBLICATION DATE (45) :

APPLICATION NUMBER (21) : P3414556.7

APPLICATION DATE (22) : 19840417

ADDITION TO (61) :

INTERNATIONAL CLASSIFICATION (51) : C02F 3/34

DOMESTIC CLASSIFICATION (52) :

PRIORITY COUNTRY (33) :

PRIORITY NUMBER (31) :

PRIORITY DATE (32) :

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TITLE (54) : METHOD FOR BIOLOGICAL REMOVAL OF
NITRATE AND/OR NITRITE FROM
WATER

FOREIGN TITLE [54A] : Verfahren zur biologischen
Entfernung von Nitrat und/oder
Nitrit aus Wasser

Claims

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1. A method for biological removal of nitrate and/or nitrite from water, in which the water is treated with sulfur-oxidizing microorganisms and sulfur-containing substances, characterized in that the sulfur-containing substances are applied to support materials.

2. A method as recited in Claim 1, characterized in that elemental sulfur and/or sulfur compounds of oxidation state -2 to +4 are used as the sulfur-containing substances.

3. A method as recited in Claim 2, characterized in that substances are also added to the water, the sulfur-containing substance, and/or the support material that promote the biological removal of nitrate and nitrite.

4. A method as recited in Claim 1, characterized in that dolomite, pumice, gravel, VA coke, or activated carbon is used as the support material. /2

5. A method as recited in one of the Claims 1 through 4, characterized in that the support material is used in the form of a powder, a granulate, or round or cylindrical briquette.

6. A method as recited in one or more of the Claims 1 through 5, characterized in that a support material is used as the sulfur-impregnated support material in which the sulfur-containing substance

* Numbers in the margin indicate pagination in the foreign text.

is deposited in an amount of 5 to 95 wt%, with reference to the total amount of support material.

7. A method as recited in one or more of the previous Claims, characterized in that the sulfur-containing substance is deposited on or in the support material by one of the following methods:

(a) Transfer of the sulfur or sulfur-containing compound into the gas phase and condensation on the support material;

(b) Dissolution of the sulfur or sulfur compound in a solvent and impregnation of the support materials with the solution;

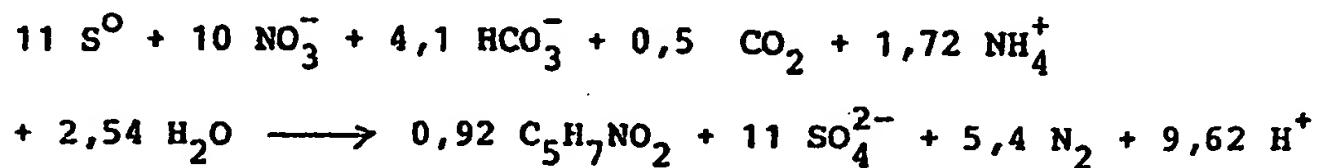
(c) Mixing the sulfur or sulfur-containing compound with the support material and optionally heating the mixture. /3

This invention relates to the autotrophic treatment of water /4 to remove nitrate and/or nitrite. In particular, it relates to the autotrophic treatment of water using sulfur-oxidizing microorganisms.

Nitrates and nitrites in water are forms of pollution that must be removed because of their harmfulness. Below, the term "water" will refer to both drinking water and industrial and waste water. According to current regulations, drinking water must contain no more than 90 mg/l nitrate (NO_3^-) and 0.1 mg/l nitrite (NO_2^-), whereby the upper limit for nitrate is expected to be reduced to approximately 50 mg/l.

It is known to treat water biologically to remove nitrate and/or /5

nitrite using sulfur-containing substances in the presence of sulfur-oxidizing microorganisms. These bacteria are ubiquitous. They utilize carbon only in inorganic form (CO_2 , H_2CO_3 , HCO_3^- , or CO_3^{2-}), so that they are autotrophic bacteria. They reduce nitrate and nitrite to nitrogen (N_2) and are not assimilatory to ammonia, making them dependent on ammonium salts (NH_4X) as a nitrogen source. The denitrification occurs approximately according to the following reaction equation:



This equation is valid for the use of elemental sulfur which, thus far, has been used in practice primarily as an electron donor in biological nitrate removal in pulverized or granulated form. The biological reaction can be carried out in a conventional manner in stirred-tank or fixed-bed reactors. If stirred-tank reactors are being used, then pulverized or granulated sulfur is used. It is then separated in a downstream settling tank by sedimentation and returned to the stirred-tank reactor. In the case of fixed-bed reactors, granulated sulfur is typically used, optionally together with inert filter materials, such as gravel.

For water treatment, particularly treatment of drinking water, /6 it must be assured that no elemental sulfur enters the denitrified water. The Drinking Water Ordinance of 19 December 1959 provides that

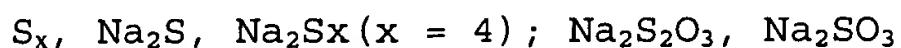
an unspecified additive may be used for preparing drinking water only if, after the treatment process, it is not analytically detectable in the drinking water. The same applies to sulfur-containing substances.

The object of this invention is, in a method for the biological removal of nitrate and/or nitrite from water using sulfur-oxidizing microorganisms and sulfur-containing substances, to assure that the sulfur-containing substances, including elemental sulfur and chemically bound sulfur, do not end up in the purified water. Related to this object is the optimization of the method described at the outset for its application in practice.

This object is achieved in accordance with this invention in that the sulfur-containing substances are applied to support materials and used in this form to autotrophically denitrify the water that is to be purified.

The water that is to be purified can be drinking water, although the method of this invention is also suitable for purifying other types of water, such as industrial and household waste water. The method of this invention can be inserted as a special step into an overall processing or purification process. /7

Possible sulfur-containing substances are, in particular, elemental sulfur or sulfides or thiosulfates. Examples are:



In general, the sulfur in the sulfur-containing substance is present in the oxidation state of -2 to +4.

Suitable support materials are, for example, dolomite, pumice, gravel, VA coke, or activated carbon. Porous materials, such as activated carbon, are preferable, because the sulfur-containing substance penetrates into the pore structure, forming a large specific surface area. It has been found, for example, that sulfur settles exclusively on the inner surface of activated carbon and is bound there.

The support materials is loaded with the sulfur-containing substance in such a way that the sulfur-containing substance is deposited in an amount of 5 to 95 wt%, with reference to the total amount of support materials. The optimum degree of deposition within the given range depends on the type of support material, the type of sulfur-containing substance that is used, and the type of water that is to be purified and can be readily determined by the proper experimentation. /8

The support material can be impregnated with the sulfur-containing substance in various ways:

- (a) Transfer of the sulfur or sulfur-containing compound into the gas phase and condensation on the support material,
- (b) Dissolution of the sulfur in an organic solvent or preparation of a suspension or dispersion in a solvent and placing the support materials in the solution, suspension, or dispersion. The

support material that is impregnated with sulfur or sulfur compound is then taken from the solvent and the solvent removed.

(c) Mixing the sulfur or sulfur-containing compound with the support material, after which the result is optionally heated, for example to 120 to 3,000°C for 1 to 40 hours.

Finally, catalytic oxidation of the hydrogen sulfide to elemental sulfur in the gas phase with oxygen in the presence of a support material is also possible.

Water treatment in accordance with this invention in the presence of sulfur-oxidizing microorganisms and sulfur-containing substances can be carried out continuously or batchwise. Suitable reactors or columns can be used for this purpose.

With the method of this invention, it is also possible and advantageous if substances are also added to the water, the sulfur-containing substance, and/or the support material, that promote the biological removal of nitrate and nitrite. The following substances are possibilities: NH_4^+ , CO_2 , H_2CO_3 , HCO_3^- , CO_3^{2-} , and rare elements such as Mo or Ni in small concentrations.

The following advantages are achieved using the method of this invention:

1. If commercially available support materials are impregnated with sulfur, the physical properties of these support materials required for classic filtration do not change. Consequently, it is possible to use layer thicknesses of approximately 2 or more meters,

which are common in water treatment. The filter can also be cleaned in counterflow with no additional measures. In practice, sulfur that is not applied to support materials, e.g., in the form of a granulate, cannot be used satisfactorily as a filter material, since the loss of pressure in such a filter due to the reduction in grain size caused by the use of sulfur, is constantly reduced, so that the packing becomes more dense.

2. The sulfur or sulfur-containing material sticks to the /10 surface of the support material, in particular to the inner surfaces. As a result, it is not dislodged by hydraulic shearing forces or mechanical friction among the bodies themselves during back-flushing. This prevents it from entering the denitrified water. This is a significant advantage, in particular, in the treatment of drinking water.

3. Sulfur on a porous material provides a significantly greater specific surface area than that provided by a granulate. Consequently, a greater microbial population density and a correspondingly greater nitrate degradation efficiency can be achieved per unit volume.

4. When support materials impregnated with a sulfur-containing substance are used, the bacteria populate the inner surface. Thus, they are protected from shearing forces and friction from the outside.

5. When activated carbon or activated coke is used as the support material, it activates the biological efficiency and accelerates the microbial conversion. This advantage is not found in pulverized or

granulated sulfur even when the sulfur-containing material is mixed with activated carbon, since the catalytic substrate activation is effective with the method of this invention only if the bacteria, substrate, and activator are in close spatial proximity.

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The invention will be described in the following examples.

Example 1

Activated carbon with a grain size of 1.5 to 4 mm was impregnated with elemental sulfur using a charging amount of 33 wt%. 35 liters of this impregnated activated carbon was placed into two columns (diameter 100 mm, height 3 m) up to a layer height of 2 x 2 m. The water to be denitrified(30 liter/h, 35 mg/liter nitrate) was sent to the columns successively in upward flow. Following a biological break-in phase of ca. 15 days, no more nitrate could be detected at the outlet of the second column.

Example 2

A thoroughly mixed stirred-tank reactor (contents 50 liters) with a downstream sedimentation tank (contents 50 liters) and sludge return received a continuous flow of untreated water (25 liter/h, 35 mg/liter nitrate). 5 kg powdered carbon impregnated with elemental sulfur and sodium polysulfide (Na_2S_x , $x = 4$) (total degree of charge 30 g/100 g carbon) was added. After two days, denitrification began. After 14 days of testing, no more nitrate could be detected at the outlet of the sedimentation stage.

The temperature in Examples 1 and 2 was 9 to 11°C in each case.

PTO 04-3869

CY=DE DATE=19980806 KIND=A1
PN=198 07 406

BIOACTIVE COMPOSITE PRODUCT ON THE BASIS OF ZEOLITE FLOUR, ITS PRODUCTION,
AND USE IN WASTEWATER TREATMENT
[Bioaktives Verbundprodukt auf der Basis von Zeolithmehl, seine
Herstellung und Verwendung zur Abwasserbehandlung]

HEINZEL, KLAUS; IPA BIO-ENTSORGUNGS- UND RECYCLINGTECHNOLOGIE GMBH

UNITED STATES PATENT AND TRADEMARK OFFICE
Washington, D.C. June 2004

Translated by: FLS, Inc.

PUBLICATION COUNTRY (19) : DE

DOCUMENT NUMBER (11) : 19807406

DOCUMENT KIND (12) : A1
(13) : PUBLISHED APPLICATION

PUBLICATION DATE (43) : 19980806

PUBLICATION DATE (45) :

APPLICATION NUMBER (21) : 19807406.9

APPLICATION DATE (22) : 19980221

ADDITION TO (61) :

INTERNATIONAL CLASSIFICATION (51) : C02F 1/28; C02F 3/00; C12N 11/14

DOMESTIC CLASSIFICATION (52) :

PRIORITY COUNTRY (33) :

PRIORITY NUMBER (31) :

PRIORITY DATE (32) :

INVENTOR (72) : WISHES TO BE UNNAMED

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BIO-ENTSORGUNGS- UND
RECYCLINGTECHNOLOGIE GMBH

TITLE (54) : BIOACTIVE COMPOSITE PRODUCT ON THE
BASIS OF ZEOLITE FLOUR, ITS
PRODUCTION, AND USE IN WASTEWATER
TREATMENT

FOREIGN TITLE [54A] : BIOAKTIVES VERBUNDPRODUKT AUF DER
BASIS VON ZEOLITHMEHL, SEINE
HERSTELLUNG UND VERWENDUNG ZUR
ABWASSERBEHANDLUNG

Description

The invention is in the area of biological wastewater clarification in sewage treatment plants and particularly relates to composite products on the basis of stone flour, specifically, of zeolite flour.

In principle, the biological clarification of industrial and communal waste waters occurs by means of aerobic and anaerobic bacteria, such as nitrosomonas, nitrobacter, acinetobacter, as well as related and adapted strains, which, with an appropriate C : N :P ratio in the bacteria nutrients, split macromolecules into nitrogen and other decomposition products, such as water and carbon dioxide, with the assistance of so-called biocatalysts (hydrolases, ureases, transferases, and other enzymes).

The "finished" activated sludge contains sludge flock, the inorganic core of which generally consists of 20 to 25 wt.% calcium oxide, 17 to 20 wt.% aluminum oxide, 6 to 7 wt.% iron oxide, 30 to 35 wt.% silicon oxide, and 12 to 15 wt.% phosphorus pentoxide, and exhibits a diameter of 100 to 300 μm . The chemical composition of the active sludge is the following, relative to the dry residue:

Element	C	N	H	O	P	S	K	Ca	Mg	Fe
Wt.%	50	14	8	20	3	1	1	0.5	0.5	0.2

It consists of 70 wt.% organic and 30 wt.% inorganic constituents.

In order to promote biological processes and to meet public agency regulations and provisions, various process steps are required, which are described in the pertinent specialized literature. Various treatment products, chemicals, adsorbing agents, filters, ion exchangers, etc.,

were used to realize the prescribed purity level. Because of the great number of potential contamination components in the water - cations like ammonium or heavy metals, anions, such as phosphates or sulfates, then also hydrocarbons, fats, proteins, and carbohydrates, etc. - several water treatment products must be used in most cases. Added to this is the fact that the contaminations may be present in very different forms, namely as actual solutions, colloids, suspensions, dispersions, etc. Depending upon the contaminations, they are biologically removed through ion exchange, precipitation, deflocculation, filtration, centrifugation, oxidation, reduction, osmosis, electrolytes, or with the assistance of microorganisms.

Due to disturbances in the biological process sequence which are caused by toxic substances and which act inhibiting on the bacteria division, filamentary colonies of bacteria form easily, which, in turn, can have the result that a bulking sludge is formed, and the required waste water values cannot be adhered to. As a result, disturbances in the sludge treatment can also occur.

To remove phosphorus compounds from the water, metal salts, such as iron and/or aluminum salts or calcium compounds are used, which, in addition, due to the hydroxide flock, also possess adsorbent characteristics and improve the sedimentation speed, the sludge index, and the filtering properties of the activated sludge.

Especially in biologically operated industrial sewage treatment plants, missing nutrients (C, N, P), but also bacteria cultures that can

be adapted, mixed with enzymes and nutrients are further added to the waste water. The supply is also often continuous.

Mineral and/or organic carriers for the bacteria cultures, so-called immobilization carriers, on the basis of stone meal, clay, zeolite, talcum, lignite, or activated charcoal, have also already successfully been added to the activated sludge. Thus, in EP 0177543B1 and in "AWT Waste Water Technology, Waste Handling Technology, and Recycling", Special Edition, Vol. 2, April 1992, the suggestion was made that finely ground zeolites, such as minoptilolite or mordenite (ptilolite), be added to the waste waters in the sewage treatment plants as carriers for the immobilization of microorganisms, as adsorbent substances, catalysts, or coagulants. The coagulating effect is in part based on a selective ion exchange and adsorption. As an additional welcome effect, the chemical precipitation of a part of the ammonium and heavy metal cations occurs. Afterwards, the material is filtered off.

Moreover, zeolite-containing natural stone has the advantage that it selectively exchanges ammonium ions and adsorbs organic molecules of the appropriate size due to its meso- and macropore structure ("molecular screening effect"). Such a zeolite-containing material represents a fine immobilization carrier.

The disadvantage is, however, that the immobilization period is four to six weeks if such zeolite-containing stone flour is mixed into the activated sludge and that natural zeolite acts bactericidal, which is particularly disruptive in the remetering of the biological balance of the sewage treatment plant. The metering in of zeolite, regardless whether

it occurs continuously or discontinuously, results in permanently bactericidal effects. Therefore, an overdosage has to occur. Because of that, the solid substance charge must, as a matter of necessity, be increased; as a rule, 30 to 50 g per cbm of waste water are added. Accordingly, more sludge is created, of course, the elimination of which is elaborate.

As a result of the overdosage, the biological output can, at best, be increased by 30 to 40%.

The disadvantages of both the economic and ecological kind that are associated with the familiar sewage treatment and clarification methods and the familiar agents and additives that are used are eliminated by means of the present invention. Surprisingly, it was found that, when the water treatment composite product defined in Claim 1 and the Sub-Claim 2 is used, the immobilization period is substantially shortened, the required relative solid substance charge, and, in connection with it, the amount of sludge incurred, is substantially reduced and the biological output can be markedly increased.

The subject of the invention is a bioactive composite product for the treatment of water, specifically waste water, on the basis of zeolite flour, which is characterized in that the zeolite particles are sorptively loaded with a bacteria nutrient. Additionally, they may possibly also be loaded with enzymes and/or bacteria.

Instead of zeolite, other stone flours - which may, possibly, contain zeolite - can also be used. Other suitable stone flours, e.g., include talcum, bentonite, or lignite, as long as they exhibit sufficient porosity.

As bacteria nutrients, numerous substances are options. Examples include: saccharides, among them, mono- and oligosaccharides, which are generally summed up as "sugars", amino sugars, amino acids, phosphates, bicarbonates, etc., and, as "adhesive substances" among the nutrients polysaccharides, options include low-molecular denatured starch, alginates, etc. Bacteria nutrients are generally familiar and the expert can make the most beneficial selection on a case by case basis.

Furthermore, the subject of the invention is a method for the production of the inventive composite product which is characterized in that zeolite granulate is ground and micronized in the crystal- and/or adsorption water-containing state, whereas the nutrient can be admixed prior to or during the grinding process and/or micronization, or that zeolite granulate is ground, micronized, and dehydrated, and mixed with bacteria nutrient in an aerosol form.

The subject of the invention is also the use of this novel composite product for the clarification of waste water, especially, of industrial or communal waste waters in biological sewage treatment plants.

In the following text, the present invention shall be described more closely by means of the preferred ways of implementing it. The zeolite particles form the inorganic crystallization germ and, after being loaded with bacteria nutrients and, possibly, enzymes and bacteria, they represent a biogenic exopolymer. The inventive composite product can be described as an already bioactivated zeolite. The disadvantages that are associated with the state-of-the-art products due to their

bactericidal effect, and which were shown above, are overcome in accordance with the invention.

Suitable bacteria nutrients generally exhibit C : N : P ratios in the proximity from 100 to 20 to 3. In the event of deviations from this ideal ratio, the invention can still be implemented, but the described advantages are lost more and more then.

To produce the inventive bioactivated composite products in accordance with a first variant, the bacteria nutrients can be added pulverized prior to the grinding process or directly during the grinding process in a mill in an appropriate weight and volume ratio by means of the preferred composite products on a zeolite basis, a zeolite granulate, which is present in a water-containing state, meaning, that it contains approximately 20 wt.% of crystal and adsorption water. During the grinding process and micronization, preferably, to a particle size of 30 μm in diameter, an intimate mixing and distribution of the substrate substances and other blend components occurs. The heat which is physically generated during the grinding process causes the release of the bound water which dissolves the C/N/P-containing nutrients. Thus, the nutrients can diffuse into the macropores of the zeolite. During the further grinding process, which is also described as micronization, the water evaporates completely and, finally, a nearly anhydrous (water content about 2 to 5%), homogeneous, bioactivated, micronized zeolite substrate is obtained which exhibits an organic-inorganic coating in both the macropores and the porous surface.

In accordance with a second variant of the above-described production process, the nutrients are now added to anhydrous zeolite flour obtained through grinding, micronization, and dehydration at, for instance, 250 to 500 degrees C, in the form of an aerosol. The nutrient solution or suspension, e.g., is sprayed on as a mist in a finely dispersed homogeneous form. This variant is less preferable, however, because, firstly, due to the required dehydration step, the energy expenditure is higher and, secondly, less nutrient is taken up or adsorbed by the zeolite cores than pursuant to the former variant, which, therefore, is preferable. The degree of the core's bacteria nutrient saturation reaches a maximum of 30 wt.%, but, generally, more than 20 wt.%.

As milling apparatuses, the familiar comminuting and micronizing apparatuses are appropriate, such as ball grinders, hammer blow grinders, or jet mills.

If the work is to be carried out with diluted nutrient solutions, and/or the drying and dehydration of the zeolite is to be avoided, classical drying methods, such as drying in a vacuum, in a spray tower, or through freezing, etc., can be used.

The bioactive composite product can also be prepared as a "slurry", whereas the nutrients are added in liquid form, e.g., as solutions. So that a stable, pumpable slurry is obtained, the recommendation is to add 2 to 5 wt.% bentonite (montmorillonite) if it is not already contained in the zeolite as a mineral. Under the effect of sodium hydrogen carbonate, bentonite or its main component montmorillonite, can be partially swelled, and, thereby, bring about a thixotropic condition.

In accordance with another configuration of the invention, the bioactivity of the new composite product can be increased even further by incorporating enzymes, such as hydrolases, ureases, transferases, etc., in the composite product. As "biocatalysts", such enzymes already assume the job of splitting organic macromolecules in the feeder of the biological sewage treatment plant regardless of the bacteria that are present and, thus, deliver usable nutrients to the bacteria or enhance the offered nutrients.

In accordance with an additional configuration of the invention, the appropriate microorganisms, namely, nitrosomonas, nictrobacter, acinetobacter, as well as related and adapted strains, can be incorporated in the novel bioactive composite product. This variant is particularly appropriate in highly loaded facilities, or for the startup phase of a biological sewage treatment plant.

Substantial technical advantages are associated with the inventive bioactive composite products. Thus, as already mentioned, not only can the immobilization times, meaning periods within which bacteria settle on the suspended particles or sludge flock, be shortened and the necessary relative introduction of solid substance and the incurred sludge reduced, and the biological performance can be markedly increased, but a number of additional advantages can be realized which will be mentioned below.

The zeolite cores that are loaded in accordance with the invention have a tendency to coagulation and very rapidly conglomerate into stable sludge flock.

Activated sludge flock is comprised of active marginal zones, predominantly inactive bacteria, and a mineral core. Depending upon the impacting shearing forces, this flock is 100 to 300 μm in size, and its density is 1.01 to 1.02 g/ccm.

Saprophytic microorganisms are quickly and safely immobilized both on the surfaces and on the micropores of the porous zeolite cores (porosity 20 to 30 ccm per 100 g) of an inventive composite product that are accessible for the bacteria. The adhere firmly and "settle" on the adhesive surfaces of, e.g., 30 qm/g which have been bioactivated by means of the incorporated nutrients, find the incorporated nutrients there, and unfold their bioactivity. The enzyme production of the bacteria is enhanced as a result of the "environment and mass offer", so that harmful substances can be devoured more rapidly.

The oxygen absorption is improved due to the capillary structure of the zeolite flock (increased "breathing activity"). For this reason, the introduction of oxygen can be reduced in comparison with familiar sewage treatment methods. Moreover, the zeolite flock is less sensitive to shearing forces.

The density of the activated sludge flock is increased to 1.02 to 1.04 g/ccm when the invention is applied. In conjunction with this, the sludge index and sedimentation are improved.

The active bacteria percentage increases drastically. As a result of the intensified proliferation of bacteria, the enzyme production increases as well and the nitrification-denitrification processes accelerate. Due to the high ion exchange capabilities of the composite

product, ammonium ions are directly made available to the microorganisms for utilization.

The phosphorus intake in the bio mass, as well as the intake of phosphorus by the bacteria, is improved. The ability to absorb organic compounds is enhanced. Toxic heavy metal ions are bound through ion exchange.

Because of the flexibility with regard to the selection of the bacteria nutrients in the production of the novel water treatment composite products, a customized treatment product can be provided for every sewage treatment plant. If any given sewage treatment plant was deficient in N, for instance, the amino acid content in the nutrient blend will, e.g., be increased. If P is deficient, this can be compensated by adding phosphate to the nutrient blend, etc.

In summary, the most important advantages that can be realized with the invention can be characterized as follows: the harmful substance units (SE) are reduced by up to 70%. Costs are saved because less energy is required and more economical chemicals can be used. The sewage treatment plants can be loaded further hydraulically. The formation of bulking sludge, floating sludge, or foam is prevented or reduced.

The invention will be described further by means of the following configuration examples.

Example 1

A naturally occurring zeolite with a graining of up to 2 mm was used as a starting material. This fine granulate contained up to 20 wt.% crystal- and adsorption water.

For the grinding and micronization, a ball grinder with a conveyor speed of 2 to/h. was used. During the continuous grinding and micronization, a prepared pulverulent nutrient blend was mixed into the granulate through the filling funnel in the ball grinder, which was comprised of

3 parts glucose
3 parts glutamic acid
1 part sodium hydrogen carbonate
0.5 parts potassium phosphate
0.1 parts dextrin.

Additional important elements, such as Ca, Mg, Fe, are already naturally contained in zeolite.

An intimate mixing of the metered-in nutrients among themselves and with the zeolite granulate occurs in the heated grinder. Over the course of the grinding process, this blend is heated. Together with the released adsorption heat, the heat has the effect that the substrates dissolve and water evaporates. Under pressure, an exchange of the ions takes place in the micropores and the colloids are adsorbed in the macropores. After the complete evaporation of the released water, the process comes to an end.

The continuously discharged bioactive composite product contains approximately 20 wt.% nutrient relative to zeolite.

Example 2

In a plant test, an inventive composite product was continuously charged into a sewage treatment plant (50,000 PE (= population equivalent), about 10,000 cbm) for 24 hours in such a quantity that a concentration of 10 g/cbm resulted. The composite product was a zeolite which had been

micronized below 30 µm, which was loaded with 120 mg of glucose, 50 mg of glutamic acid, 50 mg of sodium hydrogen carbonate, and 30 mg of dextrin per gram of zeolite.

The excellent clarification results that were obtained are compiled in the following table:

Draining ditch efflux values	Blind test mg/l	Invention mg/l	Reduction realized in %
CSB	55	20	64
BSB5	10	4	60
P	3 (with FE salt)	1 (w/o FE salt)	67

(CSB - chemical oxygen requirement; BSB5 =biological oxygen requirement in 5 days)

Clarification performance prior to biological filter			
CSB	110	35	68
Clarification performance after biological filter			
N (ammonium)	9	2	78
Ammonium discharge; septic tower			
	950	350	63
Clarification performance; digested water			
CSB	1360	560	59
Digestion time; reactor			
	36 days	22 days	39
Dry substance;			
intermediate sedimentation tank			
	4 wt.%	9 wt.%	
Dry substance;			
predensifier	6 wt.%	13 wt.%	

Patent Claims

1. Bioactive water treatment composite product on the basis of zeolite flour, characterized in that the zeolite particles are sorptively loaded with bacteria nutrient.

2. Composite product in accordance with Claim 1, characterized in that the zeolite particles are loaded with enzymes and/or with bacteria.

3. Process for the production of the composite product in accordance with Claim 1 or 2, characterized in that zeolite granulate is ground and micronized in a crystal- and/or adsorption water-containing state together with bacteria nutrient, whereas, prior to grinding or during grinding and/or micronization, the nutrient is mixed in, or that zeolite granulate is ground, micronized, and dehydrated, and mixed with bacteria nutrient in an aerosol form.

4. Use of the composite product in accordance with Claim 1 or 2 for the clarification of waste water in biological sewage treatment plants.

5. Use in accordance with Claim 4, characterized in that industrial or communal waste waters are clarified.